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POSSIBILITY OF EXISTENCE OF HIGH ELECTRON CONCENTRATIONS
IN THE NIGHT ATMOSPHERE OF VENUS

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POSSIBILITY OF EXISTENCE OF HIGH ELECTRON CONCENTRATIONS
IN THE NIGHT ATMOSPHERE OF
VENUS

(O vozmozhnosti sushchestvovaniya v nochnoy atmosfere Venery
vysokikh elektronnykh kontsentratsiy)

GEOMAGNETIZM I AERONOMIYA,
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by A. D. DANILOV
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(SHORT COMMUNICATIONS)

It was indicated in recent works by A. E. Salomonovich, A. D. Kuz'min [1] and Mayer & al. [2], that radio observations of Venus in the 10 cm wavelength gave high temperatures for the emitting regions. The assumption that the obtained high temperatures are related to the upper layers of Venusian atmosphere can only be substantiated by the presence at Venus of a powerful nighttime ionosphere. Johnes [3] considers as a possible agent creating such a ionosphere the proton fluxes, which may be sufficiently powerful in the Venusian atmosphere, provided its magnetic field is about $1/30$ -th of the geomagnetic field.

The investigation of the possibility of existence in principle of high electron concentrations in the night atmosphere of Venus, offers interest. A model of Venus ionosphere was constructed

in reference [4] on the basis of examination of ionization and recombination processes similar to those taking place in the terrestrial atmosphere. This is done on the assumption that the atmosphere of Venus consists of CO_2 at all heights. Thus, molecular CO_2^+ and CO^+ ions exist in the venusian atmosphere to very great heights, and the effective recombination coefficient of electrons, conditioned by these ions' dissociative recombination processes, is sufficiently high. The indicated discussions led to diurnal electron concentrations of the order of 10^6 electron/cm³sec [4]. However, the ionosphere formation should be examined under conditions when the recombination coefficients of the processes, and consequently the effective recombination coefficient are sufficiently low. Such situation may take place in the case, when beginning with certain altitudes, the atmosphere of Venus consists only of neutral and atomic ions because of dissociation. The recombination coefficient is very low for the latter (radiative recombination) and constitutes 10^{-12} cm³ sec⁻¹ [5]. The second possibility resides in that the transformation reaction of atomic O^+ ions into molecular ions by way of charge exchange with CO_2 molecules may not be as effective in comparison with the terrestrial ionosphere as it has been admitted in [4]. If this reaction is of little effectiveness, the atomic oxygen ions will also disappear by way of radiative recombination.

The effective recombination coefficient α' in the Venusian ionosphere will have in both examined cases an order of 10^{-12} cm³sec⁻¹.

It must be noted that precisely this value of α' was admitted in the above referred-to Johnes computations. For that α' value the magnitude of the integral $\int n_e^2 dz$, estimated on the basis of radio data is of $3 \cdot 10^{24}$ to $3 \cdot 10^{25} \text{ cm}^{-5}$ [1, 2]. It leads to the total amount of recombinations in the Venusian atmosphere column equal to $3 \cdot 10^{12} - 10^{13} \text{ recomb/cm}^2 \text{ sec}$. Thus, for the admitted effective recombination coefficient the question of whether radio observation data may be related to the Venusian ionosphere amounts to the examination of the possibility of existence in the night atmosphere of Venus of a ionizing agent, capable of balancing the indicated high number of recombinations.

Let us return to the Earth's night ionosphere. It was shown in reference [6] that the existence of night ionization at the level of the F-layer, just as that of the ionosphere during the polar night, cannot be explained without assuming the presence of an ionizing agent in the atmosphere, that would be distinct of solar radiation and active in nighttime. According to computations brought out in that work, soft electron fluxes are responsible for the ionization in nighttime at the F-layer heights. The number of recombinations in the night ionosphere column obtained in that work was equal to $2 \cdot 10^{10} - 10^{11} \text{ recomb/cm sec}$. However, when computing this magnitude, diurnal values of electron recombination coefficient α' , taken according to [7], were utilized. Inasmuch as the value of the latter increases in nighttime [8] at the expense of the experimentally detected increase in the share of molecular ions, this estimate must be revised. The computations carried out with the

accounting of the nighttime increase of the effective recombination coefficient, give $10^{11} - 10^{12}$ recomb/cm²sec for the number of recombinations in the terrestrial atmosphere. Because of the uncertainty in the knowledge of the coefficient of dissociative recombination reactions determining α' , two possible values of it are brought out in [6].

Thus, on the basis of comparison with the number of recombinations in the night ionosphere of the Earth, the value $\int \alpha' n_e^2 dz$, indispensable for the interpretation of radio observations, does not appear to be absolutely impossible if one assumes that the same ionizing agent acts in the Venus as in the Earth's night atmosphere. In order to explain a certain discrepancy in the indicated value of $\int \alpha' n_e^2 dz$, obtained for the Earth and necessary for Venus, one must assume that the flux of that agent is several times greater in the Venusian than in the Earth's atmosphere. Such assumption is quite acceptable, for electron fluxes may strongly depend for example on the value of the planet's magnetic field.

It follows from the above-said that the assumption of the presence in the night atmosphere of Venus of high electron concentrations, necessary to explain the radio observation data, is not absolutely unacceptable and may, under specific conditions, be quite founded.

***** E N D *****

Translated by ANDRE L. BRICHANT
for the

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